CLAIMS

What is claimed is:

1. A method for configuring an equivalent $2^n \times 2^n$ k-stage bit-permuting network based on a given $2^n \times 2^n$ k-stage bit-permuting network having the representation $[\sigma_0 : \sigma_1 : \sigma_2 : \ldots : \sigma_{k-1} : \sigma_k]_n$, the method comprising

specifying a permutation κ on integers from 1 to n that preserves n, and

implementing the equivalent network as $[\sigma_0 : \sigma_1 : \ldots : \sigma_{j-1}\kappa : \kappa^{-1}\sigma_j : \ldots : \sigma_k]_n$, $j = 1, 2, \ldots,$ or k.

2. The method as recited in claim 1 wherein the given network is a banyan-type network and the equivalent network is a banyan-type network.

3. A method for configuring an equivalent $2^n \times 2^n$ k-stage bit-permuting network based on a given $2^n \times 2^n$ k-stage bit-permuting network having the representation $[\sigma_0 : \sigma_1 : \sigma_2 : \ldots : \sigma_{k-1} : \sigma_k]_n$, the method comprising

specifying permutations $\kappa_1, \kappa_2, \ldots, \kappa_k$ on integers from 1 to n that preserve n, and

implementing the equivalent network as $[\sigma_0\kappa_1 : \kappa_1^{-1}\sigma_1\kappa_2 : \kappa_2^{-1}\sigma_2\kappa_3 : \ldots : \kappa_{k-1}^{-1}\sigma_{k-1}\kappa_k : \kappa_k^{-1}\sigma_k]_n$.

4. The method as recited in claim 3 wherein the given network is a banyan-type network and the equivalent network is a banyan-type network.

5. A method for configuring an equivalent $2^n \times 2^n$ bit-permuting network based on a given $2^n \times 2^n$ bit-permuting network composed of stages and exchanges, the method comprising

identifying one stage from the stages of the given network, the identified stage having a preceding exchange immediately before it and a succeeding exchange immediately after it,

specifying a permutation on the integers 1 to n that preserves n,

rearranging the preceding exchange and the succeeding exchange with reference to the permutation to generate a rearranged preceding exchange and a rearranged succeeding exchange, respectively, and

implementing the equivalent network so that a stage in the equivalent network corresponding to the identified stage has the rearranged preceding exchange and

the rearranged succeeding exchange.

6. The method as recited in claim 5 wherein the permutation, denoted as κ, induces a $2^n \times 2^n$ cell rearrangement exchange X_κ, and the rearranging includes multiplying the preceding exchange by X_κ from the right-hand side to produce the rearranged preceding exchange and multiplying the succeeding exchange by X_κ^{-1} from the left-hand side to produce the rearranged succeeding exchange.

7. The method as recited in claim 6 wherein the given network has k-stages, the given network has the representation $[\sigma_0 : \sigma_1 : \sigma_2 : \ldots : \sigma_{k-1} : \sigma_k]_n$, the identified stage is stage j, and the equivalent network is of the form $[\sigma_0 : \sigma_1 : \ldots : \sigma_{j-1}\kappa : \kappa^{-1}\sigma_j : \ldots : \sigma_k]_n$, $j = 1, 2, \ldots,$ or k.

8. The method as recited in claim 5 wherein the given network is a banyan-type network and the equivalent network is a banyan-type network.

9. A method for configuring an equivalent $2^n \times 2^n$ bit-permuting network by cell rearrangement based on a given $2^n \times 2^n$ bit-permuting network composed of stages and

exchanges, the method comprising

identifying one stage from the stages of the given network, the identified stage having a preceding exchange and a succeeding exchange,

specifying a permutation, denoted as κ, on the integers 1 to n that preserves n and induces a $2^n \times 2^n$ cell rearrangement exchange X_κ,

rearranging the preceding exchange by multiplying the preceding exchange with X_κ from the right-hand side to produce a rearranged preceding exchange and by multiplying the succeeding exchange by X_κ^{-1} from the left-hand side to produce a rearranged succeeding exchange, and

implementing the equivalent network so that a stage in the equivalent network corresponding to the identified stage has the rearranged preceding exchange and the rearranged succeeding exchange.

10. A method for cell rearrangement of a $2^n \times 2^n$ bit-permuting network composed of stages and exchanges, the method comprising

selecting one stage from the stages of the given network to identify a preceding exchange and a succeeding exchange,

specifying a permutation, denoted as κ, on the integers 1 to n that preserves

n and induces a $2^n \times 2^n$ cell rearrangement exchange X_κ, and

multiplying the preceding exchange with X_κ from the right-hand side to implement a rearranged preceding exchange and multiplying the succeeding exchange by X_κ^{-1} from the left-hand side to implement a rearranged succeeding exchange.

11. A method for cell rearrangement of a given stage of a $2^n \times 2^n$ bit-permuting network composed of stages and exchanges, the method comprising

specifying a permutation, denoted as κ, on the integers 1 to n that preserves n and induces a $2^n \times 2^n$ cell rearrangement exchange X_κ,

multiplying the preceding exchange immediately before the given stage by X_κ from the right-hand side to implement a rearranged preceding exchange for the given stage and multiplying the succeeding exchange immediately after the given stage exchange by X_κ^{-1} from the left-hand side to implement a rearranged succeeding exchange for the given stage.

12. A method for rearranging a given $2^n \times 2^n$ bit-permuting network having the representation $[\sigma_0 : \sigma_1 : \sigma_2 : \ldots : \sigma_{k-1} : \sigma_k]_n$ to an equivalent $2^n \times 2^n$ bit-permuting network having the representation $[\pi_0 : \pi_1 : \pi_2 : \ldots : \pi_{k-1} : \pi_k]_n$, the method comprising

determining permutations $\kappa_1, \kappa_2, \ldots, \kappa_k$ on integers from 1 to n that preserve n, and

implementing the equivalent network with exchanges determined from $\pi_1 = \kappa_1^{-1}\sigma_1\kappa_2, \pi_2 = \kappa_2^{-1}\sigma_2\kappa_3, \ldots, \pi_{k-1} = \kappa_{k-1}^{-1}\sigma_{k-1}\kappa_k$ so that the equivalent network can be further expressed as $[\alpha : \kappa_1^{-1}\sigma_1\kappa_2: \kappa_2^{-1}\sigma_2\kappa_3: \ldots : \kappa_{k-1}^{-1}\sigma_{k-1}\kappa_k: \beta]_n$ for arbitrary permutations α and β.

13. The method as recited in claim 12 wherein an input exchange $\alpha = \pi_0$ is prepended to the equivalent network.

14. The method as recited in claim 12 wherein an output exchange $\beta = \pi_k$ is appended to the equivalent network.

15. The method as recited in claim 12 wherein an input exchange $\alpha = \pi_0$ is prepended to the equivalent network and an output exchange $\beta = \pi_k$ is appended to the equivalent network.

16. A method for configuring a given $2^n \times 2^n$ k-stage bit-permuting network to

achieve a desired trace, the method comprising

determining a permutation σ on the integers 1 to n that maps the trace of the given network term-by-term to the desired trace, and

prepending the given network with an extra input exchange induced by σ^{-1} if the permutation σ exists.

17. A method as recited in claim 16 wherein k = n and the bit-permuting network is a $2^n \times 2^n$ banyan-type network.

18. A method as recited in claim 16 wherein the trace of the given network is the sequence $t_1, t_2, \ldots, t_k$, the desired trace is the sequence $t'_1, t'_2, \ldots, t'_k$, and $t'_j = \sigma(t_j)$ for $j = 1, 2, \ldots, k$.

19. A method for configuring a given $2^n \times 2^n$ k-stage bit-permuting network to achieve a desired guide, the method comprising

determining a permutation π on the integers 1 to n that maps the guide of the given network term-by-term to the desired guide, and

appending the given network with an extra output exchange induced by π if

the permutation π exists.

20. A method as recited in claim 19 wherein $k = n$ and the bit-permuting network is a $2^n \times 2^n$ banyan-type network.

21. A method as recited in claim 19 wherein the guide of the given network is the sequence $g_1, g_2, \ldots, g_k$, the desired guide is the sequence $g'_1, g'_2, \ldots, g'_k$, and $g'_j = \pi(g_j)$ for $j = 1, 2, \ldots, k$.

22. A method for configuring a given $2^n \times 2^n$ k-stage bit-permuting network to achieve a desired trace and a desired guide, the method comprising

determining a permutation σ on the integers 1 to n that maps the trace of the given network term-by-term to the desired trace,

determining a permutation π on the integers 1 to n that maps the guide of the given network term-by-term to the desired guide, and

if both the permutations σ and π exist, prepending the given network with an extra input exchange induced by σ^{-1}, and appending the given network with an extra output exchange induced by π.

23. A method as recited in claim 22 wherein $k = n$ and the bit-permuting network is a $2^n \times 2^n$ banyan-type network.

24. A method as recited in claim 22 wherein the trace of the given network is the sequence $t_1, t_2, \ldots, t_k$, the desired trace is the sequence $t'_1, t'_2, \ldots, t'_k$, and $t'_j = \sigma(t_j)$ for $j = 1, 2, \ldots, k$ and wherein the guide of the given network is the sequence $g_1, g_2, \ldots, g_k$, the desired guide is the sequence $g'_1, g'_2, \ldots, g'_k$, and $g'_j = \pi(g_j)$ for $j = 1, 2, \ldots, k$.

25. A method for rearranging a given $2^n \times 2^n$ banyan-type network having the representation $[\sigma_0 : \sigma_1 : \sigma_2 : \ldots : \sigma_{n-1} : \sigma_n]_n$ to an equivalent $2^n \times 2^n$ banyan-type network having the representation $[\pi_0 : \pi_1 : \pi_2 : \ldots : \pi_{n-1} : \pi_n]_n$, the method comprising

determining permutations $\kappa_1, \kappa_2, \ldots, \kappa_n$ on integers from 1 to n that preserve n, and

implementing the equivalent network with exchanges determined from $\pi_1 = \kappa_1^{-1}\sigma_1\kappa_2, \pi_2 = \kappa_2^{-1}\sigma_2\kappa_3, \ldots, \pi_{n-1} = \kappa_{n-1}^{-1}\sigma_{n-1}\kappa_n$ so that the equivalent network can be further expressed as $[\alpha : \kappa_1^{-1}\sigma_1\kappa_2 : \kappa_2^{-1}\sigma_2\kappa_3 : \ldots : \kappa_{n-1}^{-1}\sigma_{n-1}\kappa_n : \beta]_n$ for arbitrary permutations α and β.

26. The method as recited in claim 25 wherein an input exchange $\alpha = \pi_0$ is prepended to the equivalent network.

27. The method as recited in claim 25 wherein an output exchange $\beta = \pi_n$ is appended to the equivalent network.

28. The method as recited in claim 25 wherein an input exchange $\alpha = \pi_0$ is prepended to the equivalent network and an output exchange $\beta = \pi_n$ is appended to the equivalent network.

29. A method for rearranging a first $2^n \times 2^n$ banyan-type network having the representation $[\sigma_0 : \sigma_1 : \ldots : \sigma_{n-1} : \sigma_n]$ with a first trace induced by a permutation τ on integers 1 to n and a first guide induced by a permutation γ on integers 1 to n to a second $2^n \times 2^n$ banyan-type network having the representation $[\lambda\sigma_0 : \sigma_1 : \ldots : \sigma_{n-1} : \sigma_n\pi]$, the method comprising

prepending an additional input exchange X_λ to the first network, and

appending an additional output exchange X_π to the first network, wherein the second network in characterized by a second trace induced by a permutation τ' on

integers 1 to n and a second guide induced by a permutation γ' on integers 1 to n such that $\tau' = \lambda^{-1}\tau$ and $\gamma' = \pi\gamma$.

30. The method as recited in claim 29 wherein the permutations τ and γ that induce the first trace and the first guide are converted to any τ' and γ', respectively, with the prepended input exchange X_λ and the appended output exchange X_π by computing $\lambda = \tau'^{-1}\tau$ and $\pi = \gamma^{-1}\gamma'$.

31. A method for configuring a given $2^n \times 2^n$ banyan-type network to achieve a desired trace wherein the trace of the given network is induced by a permutation τ on integers 1 to n, and the desired trace is induced by another permutation τ' on integers 1 to n, the method comprising

determining a permutation $\lambda = \tau'^{-1}\tau$, and

prepending the given network with an extra input exchange induced by λ.

32. A method as recited in claim 31 wherein the desired trace is 1, 2, …, n and the permutation $\lambda = \tau$.

33. A method as recited in claim 31 wherein the desired trace is n, n−1, …, 1 and the permutation $\lambda = \sigma_{\leftrightarrow}^{(n)}\tau$.

34. A method for configuring a given $2^n \times 2^n$ banyan-type network to achieve a desired guide wherein the guide of the given network is induced by a permutation γ on integers 1 to n, and the desired guide is induced by another permutation γ' on integers 1 to n, the method comprising

determining a permutation $\pi = \gamma^{-1}\gamma'$, and

appending the given network with an extra output exchange induced by π.

35. A method as recited in claim 34 wherein the desired guide is 1, 2, …, n and the permutation $\pi = \gamma^{-1}$.

36. A method as recited in claim 34 wherein the desired guide is n, n−1, …, 1 and the permutation $\pi = \gamma^{-1}\sigma_{\leftrightarrow}^{(n)}$.

37. A method for configuring a given $2^n \times 2^n$ banyan-type network to achieve a desired trace and a desired guide wherein the trace of the given network is induced by a

permutation τ on integers 1 to n, the desired trace is induced by another permutation τ' on integers 1 to n, the guide of the given network is induced by a permutation γ on integers 1 to n, and the desired guide is induced by another permutation γ' on integers 1 to n, the method comprising

determining a permutation $\lambda = \tau'^{-1}\tau$,

determining a permutation $\pi = \gamma^{-1}\gamma'$,

prepending the given network with an extra input exchange induced by λ, and

appending the given network with an extra output exchange induced by π.

38. An equivalent $2^n \times 2^n$ k-stage bit-permuting network based on a given $2^n \times 2^n$ k-stage bit-permuting network having the representation $[\sigma_0 : \sigma_1 : \sigma_2 : \ldots : \sigma_{k-1} : \sigma_k]_n$, the equivalent network comprising

permutation means for computing a permutation κ on integers from 1 to n that preserves n, and

a $2^n \times 2^n$ k-stage bit-permuting network configured as $[\sigma_0 : \sigma_1 : \ldots : \sigma_{j-1}\kappa : \kappa^{-1}\sigma_j : \ldots : \sigma_k]_n$, j = 1, 2, …, or k.

39. An equivalent $2^n \times 2^n$ k-stage bit-permuting network based on the j-th stage of a given $2^n \times 2^n$ k-stage bit-permuting network having the representation $[\sigma_0 : \sigma_1 : \sigma_2 : \ldots : \sigma_{k-1} : \sigma_k]_n$ and based on a permutation κ on integers from 1 to n that preserves n, the equivalent network comprising

an input exchange $\sigma_0\kappa$ if $j=1$, or an input exchange σ_0 if $j = 2, 3, \ldots, k$,

an output exchange $\kappa^{-1}\sigma_k$ if $j=k$, or an output exchange σ_k if $j =1, 2, \ldots, k-1$,

and

interstage exchanges $\sigma_1, \sigma_2, \ldots, \sigma_{j-1}\kappa, \kappa^{-1}\sigma_j, .., \sigma_{k-1}$ if $j = 2, \ldots,$ or $k-1$, or interstage exchanges $\kappa^{-1}\sigma_1, \sigma_2, \ldots, \sigma_j, \ldots, \sigma_{k-1}$ if $j = 1$, or interstage exchanges $\sigma_1, \sigma_2, \ldots, \sigma_j, .., \sigma_{k-2}, \sigma_{k-1}\kappa$ if $j = k$.